reSEARCH

Any initial energy source may be used to generate electricity. Power stations tend to be located close to their energy supply. For each of the generating stations listed below, determine why each station is located where it is. Copy the table and fill in the third column.

Initial Energy Source	Location of Electrical Generating Station	Why is the Generating Station Located There?
nuclear	Pickering, Ontario	
biomass	Clover Bar Landfill, Edmonton, Alberta	
fossil fuel (coal)	Keephills, Alberta	
hydro or water	Bighorn Dam, Alberta	

Begin your search at www.pearsoned.ca/school/science10

Yet another approach is to search for alternative energy sources. However, the search for new sources of energy is extremely expensive and it will be difficult to incorporate new energy sources into society and develop technologies that use the new sources. Imagine every machine that we possess having to be changed to adapt to a new energy source.

Until we develop a new energy source, the most practical solution to dwindling fossil fuel supplies is to conserve as much energy as possible by reducing our energy use. To do this, we must consume our current energy supplies efficiently. This has to be done across all fronts—personal, commercial, industrial, and transportation—until a new practical energy source is developed.

The largest consumers of energy in industrialized countries are business and industry, so it is important that they use energy efficiently. Most companies could conserve large amounts of energy by doing such things as turning out unused lights, turning off equipment or placing it in standby mode, and buying energy-efficient products. Many companies have already installed more energy-efficient lighting, heating, and cooling equipment to conserve energy.

Another less obvious method is to encourage industries to use **cogeneration**. This is the process of using waste energy from one process to power a second process. For example, in a thermal power station, the steam that is used to turn the turbines could then be used to heat local buildings before returning to the combustion chamber to be reheated. Currently in some power stations, the heat from the steam, once it has passed through the turbine, is wasted because it is vented to the outside surroundings.

TransAlta, a Calgary-based energy company, operates plants that use cogeneration. Its Cancarb Thermal Carbon Black Plant in Medicine Hat is a conventional thermal power plant that burns natural gas to create heat and electricity. Beside this plant is its Cancarb Waste Heat Recovery Power Plant, a cogeneration plant. This cogeneration plant generates steam from the waste heat created by the thermal plant to drive a turbine to generate electricity for the city of Medicine Hat. This cogeneration reduces the overall CO_2 emissions in southern Alberta by 160 000 tonnes per year.

Individuals also have to use energy efficiently. The tables below suggest some methods individuals can use to conserve energy and give statistics that can help consumers make energy-efficient choices.

Methods to Conserve Energy
Turn off all unnecessary lights.
Turn down the thermostat a few degrees at night.
Take a bus or car pool to work or school.
Avoid using energy-wasting appliances and gadgets.
Take shorter showers.

Be Aware of Efficiency Statistics
Major electric appliances must meet a minimum standard of energy efficiency. New appliances must show an EnerGuide label, which shows the appliance's yearly energy consumption in kWh. The lower the number, the more efficient the appliance.
A frost-free refrigerator uses twice as much energy as a conventional refrigerator.
An electric stove uses twice as much energy as a gas stove.
An incandescent light bulb uses three times as much energy as a fluorescent bulb.
A large sport utility vehicle uses more than three times as much energy as a smaller compact vehicle.

Achieving energy efficiency and conservation are, at present, the best solutions to preventing an energy crisis, but it can also be argued that even these are merely postponing the inevitable. Sooner or later, we will deplete all the non-renewable sources of energy.

All sectors of society must become conscious of the problem and search for a solution. The solution or solutions can't benefit just a few places for a short while; they must benefit all societies over the long term. The solution must be **sustainable**. A sustainable process will not compromise the survival of living things or future generations while still providing for our current needs.

info **BIT**

First Nations cultures teach that people should live in harmony with nature, since we are all part of nature. They do not see resources and the environment as separate. By conserving energy, we are protecting the environment and ourselves.

Sustainable Development and Planning for the Future

Sustainable development is economic development that meets current needs without compromising the ability of future generations to meet their needs. If we want to achieve sustainable development, continuing our current energy practices that emphasize depletion of non-renewable resources will not help. When we, as a society, develop large-scale energy policies for the future, we have to keep sustainability in mind. If energy policies place more emphasis on reducing current energy demands and improving efficiency of current and future power plants, they will improve the sustainability of our fossil fuel reserves. However, a more proactive approach that emphasizes research into cost-efficient ways to obtain energy from renewable resources may help society reach the goal of true sustainability. Some people believe that governments should lead the way.

B3.4 Check and Reflect

Knowledge

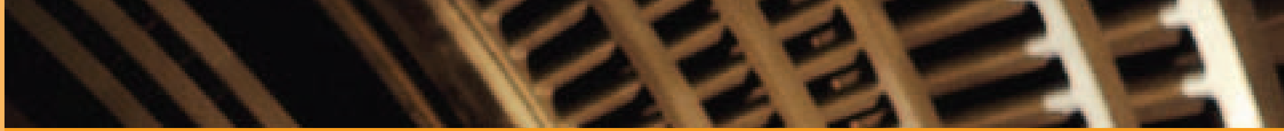
1. Give three examples of solar energy sources and three examples of non-solar energy sources.
2. What is the ultimate source of energy in the Sun?
3. What is biomass?
4. What is cogeneration?
5. What is meant by the term "sustainable"?

Applications

6. Why are fossil fuels regarded as indirect solar energy sources?
7. Explain why photosynthesis is considered a direct use of solar energy while a windmill is an indirect use of solar energy.
8. Why is biomass considered a renewable energy source?
9. What three factors are chiefly responsible for the modern strain on our supply of non-renewable energy sources?
10. Discuss the term "energy crisis."
11. Identify two short-term solutions to the energy crisis.
12. What is the most practical solution to the energy crisis?

Extensions

13. List five costs and five benefits of developing thermal power stations.
14. It has been suggested that in order to conserve energy, governments should impose a "user-pay" tax for users of fossil fuels. Give three advantages and three disadvantages of this tax.



Section Review

Knowledge

1. What is the energy conversion in a heat engine?
2. What are the two statements that describe the second law of thermodynamics?
3. Under what conditions will a machine be classified as a perpetual motion machine?
4. If you are forming a snowball with your bare hands, what is the direction of heat flow?
5. Explain the operation of a thermo-electric converter.
6. Name three sources of energy that pre-industrial societies used to operate their simple machines.
7. What are three benefits and three costs of non-renewable energy sources?
8. Why is southern Alberta a prime area for the development of windmills for the generation of electricity?

Applications

9. Describe one example in your classroom that can be explained using the first law of thermodynamics.
10. A soft rubber ball and a steel ball bearing are both dropped from the same height onto a concrete floor. Which ball do you predict will rise higher? Justify your answer and state the law of thermodynamics that is best applied to this situation.
11. Can the heat output of a heat engine be greater than the heat input? Does this violate the first law of thermodynamics?
12. Compare a hydro-electric power station and a thermal power station. Which of the two methods is the most efficient at generating electricity? Explain your answer in terms of useful and wasteful energy.
13. Explain what is meant when it is stated that the efficiency of an engine is 25%.
14. A heat engine with an efficiency of 35% has a heat input of 1000 J.
    a) What is the heat output?
    b) What happens to the rest of the energy?
15. What is the energy crisis?
16. What is the current method of solving the energy crisis?
17. To lengthen the life span of non-renewable energy sources, energy conservation can be practised by all parts of society. Describe one method of energy conservation that can be applied in the following areas:
    a) residential
    b) commercial
    c) industrial
    d) transportation
18. Explain why energy conservation and efficiency are merely postponing the energy crisis.
19. What is a better solution to the energy crisis?
20. In terms of energy content of fuels, suggest why thermal power plants in Alberta use non-renewable sources of energy such as coal and natural gas, instead of renewable sources such as wood.

Extensions

21. Explain why the freezer compartment in the older model refrigerators was always at the top.
22. How is efficiency related to the conservation of energy?
23. The hot-water heater is one of the largest consumers of energy in the home. Explain at least three ways the hot-water heater can be made more efficient.
24. If the internal combustion engine is so much less efficient than an electric motor, why do automobiles still use the internal combustion engine as a source of power?
25. How does the phrase "sustainable development" differ from the perspective of an environmentalist or an oil industry employee?

Cost-Benefit Analysis of Energy Sources for Transportation

Begin your search at www.pearsoned.ca/school/science10

Background Information

Whenever a controversial change in a technology is proposed, experts in the field are usually consulted to do a cost-benefit analysis of the technology before any further steps are taken to develop the technology. "Costs" refers to all the factors that weigh against the technology, such as negative impacts on society and the environment. "Benefits" refers to all the factors that favour the development of the technology.

Cost-benefit analyses are done often by industry and governments because they help these organizations make decisions on difficult issues.

Scenario

Imagine that you are given the task of presenting a proposal to the government concerning the advantages and disadvantages of different energy sources used for transportation. The results of your proposal will determine which type of electrical generating station is to be developed in your area.

Research the Issue

1. To enable you to present your proposal, you will need to complete cost-benefit charts like the ones shown below.
2. Identify at least three energy sources that can be used in transportation.
3. Research five costs and benefits for each energy source.

Analyze the Issue

4. In the chart, list the benefits and the costs of each type of energy source. Rate each benefit and cost using a scale of 1 to 10, 10 being the greatest benefit or cost.
5. Once you have rated all the costs and benefits, total your ratings for costs and benefits.
6. According to your results, which energy source has the greatest benefit?
7. According to your results, which energy source has the greatest cost?

Address the Issue

8. Using the information that you have researched and your analysis, prepare a cost-benefit analysis that clearly outlines how you reached your decision as to which energy source should be used.

Energy Source	Benefits	Rating (1–10)	Costs	Rating (1–10)
Gasoline	1.		1.	
	2.		2.	

Energy Source	Benefits	Rating (1–10)	Costs	Rating (1–10)
Electricity	1.		1.	
	2.		2.	

UNIT B

Project

Build an Energy Conversion Device

In this activity, you will design and build your own device to demonstrate the principles of energy conversion and transformation. At the beginning of section B3.0, in Figure B3.1, you saw an example of a Rube Goldberg machine. This is an opportunity for you to design and build your own such machine.

Criteria for Success

- Your device must perform at least three energy transformations.
- You must be able to explain what happens at each transformation.
- You must be able to describe how your working model functions and identify all places where energy is wasted.

Procedure

1. Working in a small group, brainstorm possible designs.
2. Choose one design. Draw and label the design. Identify the energy transformations and where they will take place. Identify where you think energy will be wasted.
3. Make a list of materials you will need to construct your device. Choose materials that you can bring from home or find in the science lab.
4. Have your design approved by your teacher.
5. Once you have finalized your design and chosen your materials, construct a working model of your device.
6. Test your device to see if it works and make modifications if necessary. Keep notes on any modifications you make.
7. Demonstrate your model to the class.

Analysis

1. Demonstrate and describe the energy conversions and transformations in your device.
2. Identify all the places where energy is wasted.
3. What type of energy is released as wasted energy?
4. Describe any modifications you could still make to improve your device.

Reporting

5. Create a summary report that describes how the design, construction, modification, and demonstration of your device met the criteria listed above.

Unit Summary

B 1.0 Investigating the energy flow in technological systems requires an understanding of motion, work, and energy.

Key Concepts

- one-dimensional motion
- work

Learnings

- Uniform motion is represented as a straight line on a distance–time graph and as a straight line with a slope of zero on a speed–time graph.
- All physical quantities in physics can be classified as scalar or vector quantities, depending on whether direction must be included in their measurement.
- Velocity is a vector quantity describing the displacement of an object during a time interval.
- Acceleration is a vector quantity describing the rate of change of the velocity of an object.
- If a force is applied to an object, there is a transfer of energy to the object, which causes a change in the motion of the object. For work to be done, there must be movement and a force; the force and the distance travelled must be in the same direction.
- Work being done by applying a force through a distance against an opposing force results in a transfer of energy.

B 2.0 Energy in mechanical systems can be described both numerically and graphically.

Key Concepts

- forms and interconversions of energy
- mechanical energy conversions and work
- design and function of technological systems and devices involving potential and kinetic energy, and thermal energy conversions

Learnings

- Heat and kinetic energy or potential energy can be converted into each other. This finding led to the definition of energy as the capacity to do work.
- Other forms of energy are: chemical energy, stored in chemical bonds; electrical energy, produced by moving electrons; magnetism; light energy; nuclear energy; and solar energy.
- Potential energy may be gravitational, elastic, or chemical.
- Potential energy can be converted to kinetic energy and kinetic energy can be converted to potential energy.
- According to the law of conservation of energy, the total amount of energy in a given situation remains constant.
- Evidence of energy transformations comes from observed changes, such as changes in motion, shape, or temperature.

B 3.0 Principles of energy conservation and thermodynamics can be used to describe the efficiency of energy transformations.

Key Concepts

- technological innovations of engines that led to the development of the concept of energy
- design and function of technological systems and devices involving potential and kinetic energy, and thermal energy conversions
- efficient use of energy, and environmental impact of inefficient use of energy

Learnings

- Thermodynamics is the study of the interrelationships between heat, work, and energy. The total energy, including heat, in a system and its surroundings remains constant.
- Perpetual motion or perfect machines are not possible because some of the input energy is converted to heat and lost to the surroundings.
- Heat flows from warmer objects to cooler ones and, in the process, some heat can be converted to mechanical energy to do work. The efficiency of a system is always less than 100%. You can never get as much useful energy out of a system as you put in.
- Throughout history, devices have been invented to harness different forms of energy to do work. Innovations in the technology used in different types of engines led to the development of the concept of energy.
- Over time, different people made improvements to the design of the steam engine, making it more efficient.
- The internal combustion engine depends on energy produced by burning fuel inside the engine.
- Solar energy sources include radiant energy, wind energy, water energy, biomass, and fossil fuels. Non-solar energy sources include nuclear energy, geothermal energy, and tidal energy.
- The change from the use of renewable sources of energy to non-renewable sources, the exponential growth in world population, and the increase in energy consumed per person have created a crisis in energy.

Unit Review

Vocabulary

1. Using your own words, define the following terms:

   acceleration
   cogeneration
   efficiency
   energy
   first law of thermodynamics
   force
   heat
   kinetic energy
   law of conservation of energy
   potential energy
   second law of thermodynamics
   sustainable
   system
   uniform motion
   velocity
   work

Knowledge

B 1.0

2. Classify the following terms as either scalar or vector quantities and give an example of a measurement of each (include the units and a direction if necessary):
   a) distance travelled
   b) displacement
   c) speed
   d) velocity
   e) acceleration
   f) work
   g) energy
   h) force
3. What two measurements would you take to determine the speed of an object?
4. In your own words, describe how acceleration differs from uniform motion.
5. What happens to the motion of an object when an unbalanced force is applied:
   a) in the same direction as the initial motion of the object
   b) in the opposite direction as the initial motion of the object
6. When is work done on an object?
7. Describe one situation where a force is being applied to an object and the object moves through a distance, yet no work is done on the object.
8. A force of 20.0 N is required to lift an object 1.30 m from the floor to the top of a table. How much work was done on the object?

B 2.0

9. Show how the unit for kinetic energy, which is the joule, J, is derived from the fundamental units (kg, m, and s).
10. Define kinetic energy.
11. Name two types of potential energy.
12. Describe the relationship between the weight of an object and the work done on it.
13. When a rock is projected into the air by the elastic of a slingshot, explain why the rock will go faster if the elastic is stretched an extra distance.
14. A rock is shot vertically into the air with a catapult. At what point is the kinetic energy of the rock the greatest? At what point is the gravitational potential energy the greatest?
15. Give an example of an energy transfer in:
    a) a technological system
    b) a biological system
    c) a chemical system
16. What is the energy conversion in a solar cell?
17. Explain why hydro-electric generating stations are so much more efficient than thermal generating stations.
18. Identify all the energy conversions that take place when you turn a page in this book.

Unit Review

B 3.0

19. What is the difference between a heat engine and a heat pump? Give an example of each.

20. How are the first law of thermodynamics and the law of conservation of energy related?

21. Describe a situation in your home that illustrates the first law of thermodynamics.

22. If heat is added to a perpetual motion machine, ideally what should happen?

23. How are the first and second laws of thermodynamics related?

24. Describe an example in your home that illustrates the second law of thermodynamics.

25. Draw a simplified diagram of a Newcomen steam engine and describe its operation.

26. What are two differences between the Watt steam engine and the internal combustion engine?

27. Why is coal considered as actually being energy from the Sun?

28. Describe three energy sources in your home that could be converted from non-renewable to renewable sources of energy.

29. Define cogeneration and describe an example of how cogeneration could be applied in your school.

Applications

30. Sketch a distance–time graph showing the motion of objects travelling at 10 km/h, 20 km/h, and an object at rest.

31. A car travelling at 90.0 km/h travels 180 km. How long will the journey take?

32. A bird flies straight down from its perch on the branch of a tree to the ground, a distance of 10.0 m. The bird then returns straight up to the perch. The total time of flight is 4.0 s. What is the bird's

a) distance travelled?

b) displacement?

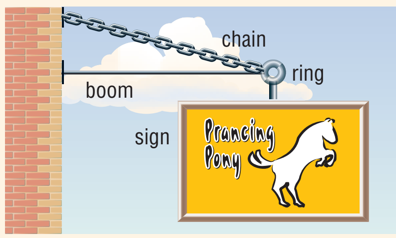
c) average speed?

d) average velocity?

33. A car accelerates from rest to 50.0 m/s [N] in 6.00 s. What is the acceleration of the car?

34. A student applies a force of 6.0 N to slide a book a distance of 0.33 m across a tabletop. Calculate the work done by the student.

35. A chain and boom mechanism is frequently used to hang advertising signs on a storefront, as shown below.



State whether each of the three forces acting on the ring (caused by the chain, boom, and sign) is a push or a pull on the ring.

36. A force of 100 N is required to push an object a distance of 5.00 m. Calculate the work done.

37. Why are water reservoirs in smaller communities placed high up on a hill or in high water towers?

38. A crate is pushed horizontally along the floor. Describe the changes in kinetic energy and in potential energy.

39. A 2.30-g bumblebee is flying at a speed of 2.50 m/s. What is the kinetic energy of the bumblebee?

40. A 2.00×10^3-kg car has a kinetic energy of 4.00×10^5 J due to its motion. What is the speed of the car?

Unit Review

41. A 0.400-kg rock is balancing on the edge of a cliff 500 m above a valley. What is the gravitational potential energy of the rock with respect to the valley below?

42. A construction worker with a weight of 800 N is walking on a steel beam high up in an office tower under construction. If the construction worker has 7.90×10^5 J of gravitational potential energy at this point, how high is the worker above the surface of Earth?

43. A cannon in a circus stunt fires a 750-N performer vertically to a height of 15.0 m. What was the speed of the performer just as the cannon was fired?

44. Each of the following describes a situation involving potential energy:
- i) Water is stored in a reservoir high up on a hill.
- ii) A model rocket is attached to its launching apparatus.
- iii) A spring-loaded toy gun is set to fire a "nerf" dart.

For each of the above situations:
- a) Identify the type of potential energy stored.
- b) Explain how the stored potential energy in each case can be made to do "useful work."
- c) Describe the type of energy into which this potential energy can be transformed.

45. After finding an AA battery in a drawer and installing it in a CD player, a student was surprised when the CD player operated, even though the student knew that the battery was at least a year old.
- a) What is the initial source of energy in a battery and why is it called potential energy?
- b) Why was the battery still functional, even after a long period of time?
- c) Where does this initial potential energy go when the battery is used to operate a CD player?

46. A 0.300-kg bullet is fired from a gun at a speed of 747 km/h. If the bullet rises straight up into the air, what is the maximum height that the bullet can reach?

47. A 2.00-N ball is lifted 1.00 m above the ground and dropped. Explain how you would determine the speed of the ball just before it hits the ground.

48. A 2.00-kg object is rolling on the floor and begins to climb an incline. Explain how you would determine the height to which the object will rise up the incline. What factor must you ignore?

49. Give an example in your home where waste heat could be reused.

50. A matchstick is rubbed on a surface and ignites. Explain all the energy conversions that take place.

51. The energy that we require for our existence comes from the chemically stored energy in food. What happens to the person whose work output is less than the energy consumed?

52. For centuries, inventors have been trying to design a perfect machine or a perpetual motion machine. Theoretically, there are different types of perpetual motion machines.
- i) Machines with an efficiency of over 100%.
- ii) Machines that can extract heat energy from a source and convert it completely to other forms of energy.
- iii) Machines that convert mechanical energy into mechanical energy, with no loss.
- a) Using the first law of thermodynamics, explain why the first situation is impossible.
- b) Describe a technology that could be explained by the statements in ii) and iii).

53. A steam engine has a heat input of 1000 J and does 350 J of useful work. What is the percent efficiency of the engine?

54. An internal combustion engine has a percent efficiency of 15%. How much is the work input if the engine lifts a 400-N object through a vertical distance of 3.50 m?

UNIT B

Unit Review

55. A hot-water bottle is filled with hot water and then sealed. Consider the hot-water bottle as a system.
  a) What would be classified as its surroundings?
  b) What type of system is it: open, closed, or isolated? Explain your answer.
  c) What type of system would it be if it began leaking?

56. How did scientists realize that the energy from the Sun could not be chemical energy from the combustion of matter?

57. A coal-burning power station has three major components where energy transformations occur.
  a) Name each component.
  b) In each component, identify a "useful" energy produced in a transfer or transformation, and a "wasteful" energy produced.

58. Consider the power plant in the previous question. Describe how cogeneration may be used to increase the efficiency of each energy transfer or transformation, and so reduce "waste" energy produced in each component.

59. Homeowners can help heat their homes by installing a fireplace that can burn wood, coal, or gas. Your neighbours have asked you to help them decide which fuel type to use. For each fuel source, identify the following:
  a) its major benefit
  b) its major drawback or risk
  c) how sustainable it is

60. In section B3.1, a hypothetical temperature-difference boat was shown as an application of the second law of thermodynamics. Theoretically, this method should be able to propel a boat. Identify and discuss two limitations of this boat. Discuss how the second law of thermodynamics prevents the boat from being 100% efficient.

Extensions

61. Describe an example where trial and error resulted in the development of a technology.

62. Why do the terms "science" and "technology" seem to go hand in hand?

63. What do you think was the most important technology developed in the 1900s? Justify your answer by stating how this technology has affected your life.

64. Whenever a transfer of energy occurs, an object may undergo a change in motion, position, or temperature. Using thermal energy as one of the energy, describe a situation depicting a change in:
  a) motion
  b) position
  c) temperature

65. What single energy conversion in your home contributes the most to the loss of energy? Can you suggest any methods to improve the efficiency of this energy conversion?

66. When an object is thrown up into the air, there is a constant change in the kinetic and potential energy of the object. Describe the changes in the mechanical energy of the object and justify your answer.

67. A 10.0-g marble is dropped from a tabletop 1.30 m above the floor. Using calculations, determine at what height above the floor the kinetic and the potential energy are equal.

68. A dog lifts a 30.0-g bone from the bottom of a hole that was 20.0 cm deep. If the dog lifts the bone to the surface of Earth, does the bone gain any gravitational potential energy? Explain your answer.

69. A pendulum is lifted to the same height on Earth and on the Moon. Explain the differences in the kinetic and potential energy.

70. Hydro, thermal, and nuclear generating stations are located in various regions in Canada.
a) Where would each station be ideally located?
b) Describe two similarities between all these types of generating stations.
c) Describe two differences between a thermal and a nuclear generating station.
d) Rate each type of generating station in terms of efficiency.

71. A superconductor is a device that can transport a current without any loss of energy. Can it be classified as a perpetual motion machine? Use the first and second laws of thermodynamics to explain your answer.

72. Describe an example where the principle of cogeneration of heat could be applied in the home.

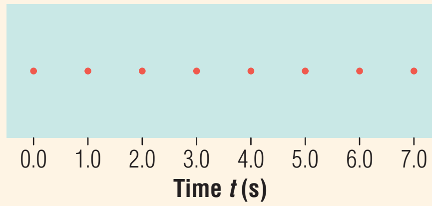
73. The following topics were listed in the agenda of a meeting of energy specialists:
a) energy conservation
b) energy efficiency
c) alternative sources of energy
d) environmental concerns

Which topic should be the most important goal for governments to consider when discussions regarding energy and the future are being held? Explain your answer.

74. How would the discovery of a new energy source to replace fossil fuels affect your home and some technologies in your home?

Skills Practice

75. The ticker tape below depicts the motion of an object:



a) Using a ruler to measure distances, complete a table of values, similar to the one shown below, depicting the distance from the starting point at various times.

Time *t* (s)	Distance *d* (cm)
0.0	

b) Draw a distance–time graph.
c) From the graph, what type of motion is the object undergoing?
d) Calculate the slope of the line of best fit.
e) What does this value represent?
f) What type of graph would depict the motion of an object that is accelerating?

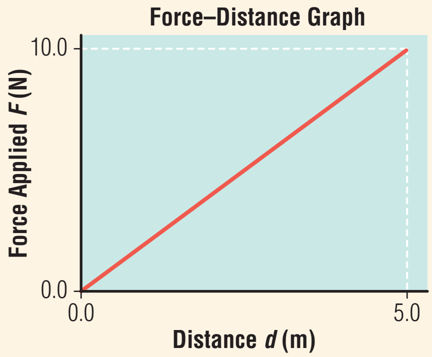
76. Use the ticker tape from the previous question.
a) Complete a table of values by calculating the speed of the object during the time intervals indicated.

Time Interval *t* (s)	Speed *v* (cm/s)
0.0 – 1.0	
1.0 – 2.0	
2.0 – 3.0	
3.0 – 4.0	
4.0 – 5.0	
5.0 – 6.0	
6.0 – 7.0	

b) Draw a speed–time graph.
c) What type of motion is displayed by the shape of the graph?

d) What would the shape of the graph be if the object was travelling with accelerated motion?
e) Calculate the slope of the line of best fit of the graph.
f) What does this value represent?
g) Extrapolate the line of the graph to 7.0 s and calculate the area under the line at 7.0 s.
h) What does this value represent?

77. The following graph represents a force being applied to move an object through a horizontal distance. Calculate the work done on the object to move it 5.0 m.

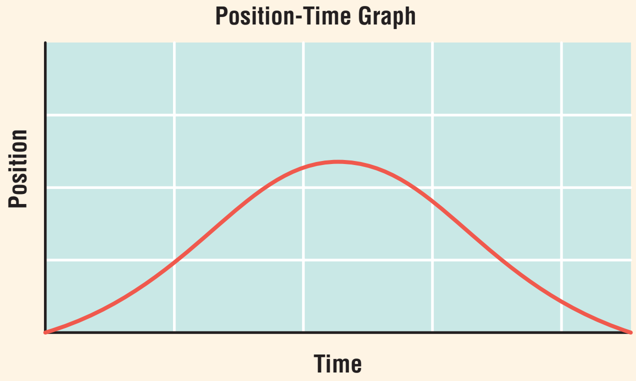


78. The position–time graph in the next column displays the motion of an object in accelerated motion. Study the graph and answer the following questions.

a) In your notebook, draw the four different segments displaying accelerated motion in the graph.

b) For each segment, identify whether the object is speeding up or slowing down. State whether the motion is in a positive or negative direction.

c) Sketch a velocity–time graph of the four accelerated motions displayed in the position–time graph.



79. Imagine that you are stranded on a small, uninhabited tropical island. After combing the entire island, you discover that the only vegetation are coconut palms, hollow bamboo plants, fruit trees, and various grasses. For protection, you decide to build a hut on a cliff overlooking the ocean and directly above a fresh water stream. Using concepts that you learned from this unit, describe a method you could devise to transport water up to the hut. Identify at least two problems that might have to be overcome in the design of your technology and discuss how your design solves each problem.

Self Assessment

80. Throughout the unit, when doing investigations and research projects, you have had to draw conclusions. In science, how important is the process of drawing conclusions? What affects how good those conclusions are?

81. Describe what you found most interesting in studying energy and technological systems in this unit.

82. Identify one issue that you would like to explore in more detail.

83. Think back to the first section of the unit. Why do you think the concept of energy was so difficult to develop and what role did technology play in helping develop the concept?

84. What changes in your own life would you undertake to conserve energy?